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Preface to the Special Issue "Integrated Monitoring in the Valkea-Kotinen Catchment during 1990–2009: Abiotic and Biotic Responses to Changes in Air Pollution and Climate"

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Increased emissions of air pollutants and greenhouse gases into the atmosphere have caused severe environmental problems at local and global scales. The long-range transport of sulphur and nitrogen oxides resulted in widespread acidification of acid-sensitive aquatic ecosystems in Europe and North America in the late 1900s (e.g. Rodhe *et al*. 1995). Airborne contamination of trace metals and persistent organic pollutants also reached the most remote regions of the world (e.g. AMAP 1998). At the same time, emissions of greenhouse gases into the atmosphere are causing global warming, and consequent climate change is considered to be among the most severe threats to the ecosystems (e.g. Rosenzweig *et al*. 2007).

Detrimental effects of transboundary air pollution led to international agreements on reducing emissions of SO_2 and NO_x in Europe and North America. International negotiations on emission reductions have been conducted under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), signed in 1979 under the UN Economic Commission of Europe (UNECE 1996). Since the 1980s, environmental regulations have led to decreased emissions of air pollutants in Europe and North America. The effects of emission reductions have been monitored by the International Cooperative Programmes (ICP) of the CLRTAP convention (Bull *et al*. 2001).

The International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (UNECE ICP IM) contains today 44 research catchments in 16 countries. In Finland, the Integrated Monitoring Programme (IM) was initiated in 1987 (Bergström 1998). Finnish Environment Institute is the leading partner in the monitoring, accompanied by other governmental research institutes (Finnish Forest Research Institute, Finnish Game and Fisheries Research Institute, Finnish Meteorological Institute and Geological Survey of Finland) and universities (Helsinki, Eastern Finland and Oulu).

The Valkea-Kotinen Integrated Monitoring catchment is one of the three active IM sites in Finland and is also part of the Finnish Long-Term Socio-Ecological Research network (FinLTSER). As a consequence of the comprehensive long-term environmental monitoring together with diverse terrestrial and aquatic ecological research (e.g. Kurka and Starr 1997, Starr and Ukonmaanaho 2004, Jones *et al*. 1999, Vähätalo *et al*. 2003, Huotari *et al*. 2009, Peltomaa *et al*. 2013a, 2013b), the Valkea-Kotinen site has grown into a major Finnish research infrastructure and data source for environmental modelling (Forsius *et al*. 1998, Futter *et al*. 2009, Saloranta *et al*. 2009, Holmberg *et al*. 2014).

This special issue of *Boreal Environment Research* summarizes the main results of the Integrated Monitoring of the Valkea-Kotinen catchment over a 20-year period (1990–2009). The seven papers included provide findings on the climate variability and trends (Jylhä *et al*. 2014), development in bulk deposition and atmospheric concentration of acidifying compounds and trace elements (Ruoho-Airola *et al*. 2014), long-term water quality trends in Lake Valkea-Kotinen (Vuorenmaa *et al*. 2014), and modelling of climate change effects on the hydrology and carbon processes of Valkea-Kotinen catchment (Holmberg *et al*. 2014). The remaining three papers present long-term biological responses to environmental changes in Lake Valkea-Kotinen, including plankton metabolism and sedimentation (Arvola *et al*. 2014), zooplankton community patterns (Lehtovaara *et al*. 2014), and perch (*Perca fluviatilis*) population dynamics (Rask *et al*. 2014).

In summary, the results clearly demonstrate the complexity of boreal nature and interactions within and between the aquatic and terrestrial ecosystems, and atmosphere. Further, these studies strongly emphasize the importance of integrated long-term monitoring of physical, chemical and biological variables for detecting the variety of impacts of changing environmental conditions on ecosystems.

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